

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Live working – Voltage detectors –
Part 1: Capacitive type to be used for voltages exceeding 1 kV AC**

**Travaux sous tension – Détecteurs de tension –
Partie 1: Type capacitif pour usage sur des tensions alternatives de plus de 1 kV**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2021 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC online collection - oc.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC online collection - oc.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Live working – Voltage detectors –
Part 1: Capacitive type to be used for voltages exceeding 1 kV AC**

**Travaux sous tension – Détecteurs de tension –
Partie 1: Type capacitif pour usage sur des tensions alternatives de plus de 1 kV**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 13.260; 29.240.20; 29.260.99

ISBN 978-2-8322-9513-7

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references	9
3 Terms and definitions	10
4 Requirements	14
4.1 General requirements	14
4.2 Functional requirements.....	15
4.2.1 Clear indication	15
4.2.2 Clear perceptibility.....	16
4.2.3 Temperature and humidity dependence of the indication.....	17
4.2.4 Frequency dependence	18
4.2.5 Response time.....	18
4.2.6 Power source dependability	18
4.2.7 Testing element.....	18
4.2.8 Non-response to DC voltage	18
4.2.9 Time rating	18
4.2.10 Electromagnetic compatibility (EMC)	18
4.3 Electrical requirements	18
4.3.1 Insulating material	18
4.3.2 Protection against bridging	19
4.3.3 Resistance against sparking	19
4.4 Mechanical requirements	19
4.4.1 General	19
4.4.2 Design	19
4.4.3 Dimensions, construction.....	19
4.4.4 Grip force and deflection.....	22
4.4.5 Vibration resistance	22
4.4.6 Drop resistance	22
4.4.7 Shock resistance	22
4.5 Markings	22
4.6 Documents for the user.....	23
4.7 Instructions for use	23
4.8 Requirements in case of reasonably foreseeable misuse of the selector	23
4.8.1 Initial position of the selector	23
4.8.2 Voltage indication at an incorrect low position of the selector (where relevant)	23
5 Specific requirements	23
5.1 For insulating element of a voltage detector as a complete device	23
5.1.1 Dielectric strength.....	23
5.1.2 Leakage current.....	23
5.2 Insulation of the indicator casing of voltage detector as a separate device	23
5.3 Stand-by state	23
5.4 Ready to operate state.....	23
6 Tests	24
6.1 General.....	24

6.1.1	Testing provisions	24
6.1.2	Atmospheric conditions	24
6.1.3	Tests under wet conditions	24
6.1.4	Type test	24
6.1.5	Test methods	25
6.2	Function tests	26
6.2.1	Clear indication	26
6.2.2	Electromagnetic compatibility (EMC)	37
6.2.3	Clear perceptibility of visual indication	38
6.2.4	Clear perceptibility of audible indication	40
6.2.5	Frequency dependence	42
6.2.6	Response time	42
6.2.7	Power source dependability	42
6.2.8	Check of testing element	43
6.2.9	Non-response to DC voltage	43
6.2.10	Time rating	43
6.3	Dielectric tests	44
6.3.1	Insulating material for tubes and rods for voltage detectors as a complete device	44
6.3.2	Protection against bridging for indoor and outdoor type voltage detectors	45
6.3.3	Protection against bridging for outdoor type voltage detector	50
6.3.4	Spark resistance	52
6.4	Mechanical tests	52
6.4.1	Visual and dimensional inspection	52
6.4.2	Grip force and deflection (only applicable for voltage detector as a complete device)	52
6.4.3	Vibration resistance	53
6.4.4	Drop resistance	54
6.4.5	Shock resistance	54
6.4.6	Climatic dependence	54
6.4.7	Durability of markings	56
7	Specific tests	56
7.1	Leakage current for voltage detector as a complete device	56
7.1.1	General	56
7.1.2	Leakage current under dry conditions	56
7.1.3	Leakage current under wet conditions (outdoor type and exclusively outdoor type)	57
7.1.4	Alternative test for voltage detectors having completed the production phase	58
7.2	Test for stand-by state	58
7.3	Test for ready to operate state	58
8	Test for reasonably foreseeable misuse of the selector	59
8.1	Initial position of the selector	59
8.2	Voltage indication at incorrect low position of the selector (where relevant)	59
9	Conformity assessment of voltage detectors having completed the production phase	59
10	Modifications	59
	Annex A (normative) Suitable for live working; double triangle (IEC-60417-5216:2002-10)	60

Annex B (normative) Instructions for use	61
Annex C (normative) Chronology of type tests	63
Annex D (informative) Classification of defects and tests to be allocated	65
Annex E (informative) Rationale for the classification of defects	67
Annex F (informative) Information and guidelines on the use of the limit mark and of a contact electrode extension	70
F.1 General.....	70
F.2 Situation when using a voltage detector as a complete device	70
F.3 Situation when using a voltage detector as a separate device.....	72
Annex G (informative) In-service care	74
G.1 General.....	74
G.2 Testing	74
Annex H (informative) Information for the next maintenance	76
H.1 Overhead line test.....	76
H.1.1 Rationale	76
H.1.2 Proposal for an improved test (will be discussed within the next maintenance).....	76
H.2 Threshold deviation ratio category (deviation category) for voltage detectors of category L.....	76
H.2.1 Rationale	76
H.2.2 Proposal for a new requirement (will be discussed within the next maintenance).....	76
H.3 Phase opposition test for voltage detectors of category L.....	76
H.3.1 Rationale	76
H.3.2 Proposal for an improved test (will be discussed within the next maintenance).....	76
H.4 Non-contact behaviour of voltage detectors of category L	77
H.4.1 Rationale	77
H.4.2 Proposal for a new test (will be discussed within the next maintenance)	77
Bibliography.....	78
Figure 1 – Examples of designs of voltage detectors of capacitive type	20
Figure 2 – Examples of suitable means for ensuring appropriate contact between a contact electrode and the ball electrode.....	27
Figure 3 – Ball and ring test set-up (see 6.2.1 and 6.2.5).....	29
Figure 4 – Test set-up with bars (see 6.2.1).....	31
Figure 5 – Circuit connections for <i>clear indication</i> tests (see 6.2.1).....	33
Figure 6 – Test set-up for measurement of clear perceptibility of visual indication (see 6.2.3.1)	39
Figure 7 – Test set-up for measurement of clear perceptibility of audible indication (see 6.2.4.1)	41
Figure 8 – Test set-up for protection against bridging and spark resistance (see 6.3.2 and 6.3.4)	48
Figure 9 – Test for protection against bridging for outdoor type voltage detector	51
Figure 10 – Test set-up for grip force	53
Figure 11 – Drop resistance test – Diagonal position	54
Figure 12 – Curve of test cycle for climatic dependence.....	55

Figure 13 – Arrangement for leakage current tests under dry conditions for voltage detector as a complete device.....	57
Figure 14 – Arrangement for leakage current tests under wet conditions for outdoor type voltage detector as a complete device.....	58
Figure F.1 – Insulation element of a <i>voltage detector</i> as a complete device	70
Figure F.2 – Example of positioning of a voltage detector in contact with a live part without obstacles from other live parts	71
Figure F.3 – Example of incorrect positioning of a voltage detector with the limit mark between two live parts	72
Figure F.4 – Usual way of managing the use of the voltage detector for maintaining the insulation distance between the limit mark and the hand guard	72
Figure F.5 – Usual ways of managing the use of the voltage detector as a separate device for assuring the appropriate insulation for the user	73
Table 1 – Indication group	17
Table 2 – Climatic categories.....	18
Table 3 – Minimum length of the insulating element (L_i) of a voltage detector as a complete device.....	21
Table 4 – Selection of the test set-up for the influence of in-phase interference field	34
Table 5 – Distance G (see Figure 5d).....	34
Table 6 – Selection of the test set-up for the influence of phase opposition interference field.....	35
Table 7 – Selection of the test set-up for the influence of interference voltage	35
Table 8 – EMC parameters	37
Table 9 – Performance criteria for all the EMC tests	37
Table 10 – Test parameters for emission limit.....	37
Table 11 – Selection of the test set-up and type of test.....	45
Table 12 – Distance d_1 for the bridging test set-up	48
Table 13 – Dimensions for the concentric rings and band electrodes	50
Table 14 – Selection of the test set-up for the spark resistance test.....	52
Table C.1 – Sequential order for performing type tests	63
Table C.2 – Type tests out of sequence	64
Table D.1 – Classification of defects and associated requirements and tests	65
Table E.1 – Rationale for the classification of defects	67
Table G.1 – In-service testing	75
Table H.1 – Maximum distances for early detection	77

INTERNATIONAL ELECTROTECHNICAL COMMISSION

LIVE WORKING – VOLTAGE DETECTORS –

Part 1: Capacitive type to be used for voltages
exceeding 1 kV AC

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61243-1 has been prepared by IEC technical committee 78: Live working.

This third edition cancels and replaces the second edition published in 2003 and Amendment 1:2009. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) The scope is more precise, stating that only bare contact to the part to be tested is reliable for these contact *voltage detectors*. The rationale is that tests on painted or coated conductors have led to wrong indications, as this non-conductive paint or coat acts as a capacitor with different capacity according to the thickness. This capacity has an effect on the *threshold voltage*.
- b) A *contact probe* is introduced as a new type of non-conductive *contact electrode*.
- c) A new type "*exclusively outdoor type*" has been defined and implemented into the requirements and test procedure.

- d) A *selector* for voltage and frequency is allowed if foreseeable misuse is excluded.
- e) The marking for *voltage detectors* with low *interference voltage* has been made more precise.
- f) The indication groups have been made more precise and requirements and tests for the "*ready to operate state*" and "*stand-by state*" added.
- g) Requirements and tests for electromagnetic compatibility have been implemented.
- h) An example for good electrical connection for the tests is introduced.
- i) A new test set-up with one bar has been added for *voltage detectors* of category L for overhead line configuration.
- j) A dielectric test for tubes and rods has been implemented for those not covered by IEC 60855-1 or IEC 61235.
- k) Old Annex E (mechanical shock test – pendulum method) has been deleted (see IEC 60068-2-75 pendulum method) and replaced by an information and a guideline on the use of the *limit mark* and the *contact electrode extension*.
- l) Annex E and Annex F have swapped places to make it easier for the reader to combine the classification of defects (Annex D) and the rationale for this classification (new Annex E).
- m) A new informative Annex H has been created to give information for further developments of *voltage detectors* due to field experiences.
- n) Editorial changes have been made to harmonize with other new published standards.

The text of this International Standard is based on the following documents:

CDV	Report on voting
78/1253/CDV	78/1294/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

Terms defined in Clause 3 are given in *italic* print throughout this document.

A list of all parts in the IEC 61243 series, published under the general title *Live working – Voltage detectors*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This document has been prepared according to the requirements of IEC 61477, where applicable.

This document is a preview generated by EVS

LIVE WORKING – VOLTAGE DETECTORS –

Part 1: Capacitive type to be used for voltages exceeding 1 kV AC

1 Scope

This part of IEC 61243 is applicable to portable *voltage detectors*, with or without built-in power sources, to be used on electrical systems for voltages of 1 kV to 800 kV AC, and frequencies of 50 Hz and/or 60 Hz.

This document applies only to *voltage detectors* of capacitive type used in contact with the bare part to be tested, as a complete device including its *insulating element* or as a separate device, adaptable to an *insulating stick* which, as a separate tool, is not covered by this document (see 4.4.2.1 for general design).

Other types of *voltage detectors* are not covered by this document.

NOTE Self ranging *voltage detectors* (formally "multi range *voltage detectors*") are not covered by this document.

Some restrictions or formal interdictions on their use are applicable in case of switchgear of IEC 62271 series design, due to insulation coordination, on overhead line systems of electrified railways (see Annex B) and systems without neutral reference. For systems without neutral reference, the insulating level is adapted to the maximum possible voltage to the earth (ground).

Products designed and manufactured according to this document contribute to the safety of users provided they are used by persons trained for the work, in accordance with the hot stick working method and the instructions for use.

Except where otherwise specified, all the voltages defined in this document refer to values of phase-to-phase voltages of three-phase systems. In other systems, the applicable phase-to-phase or phase-to-earth (ground) voltages are used to determine the *operating voltage*.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 60071-1:2019, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60417, *Graphical symbols for use on equipment* (Available from: <http://www.graphical-symbols.info/equipment>)

IEC 60942, *Electroacoustics – Sound calibrators*

IEC 61000-6-2:2016 *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61260 (all parts), *Electroacoustics – Octave-band and fractional-octave-band filters*

IEC 61318, *Live working – Conformity assessment applicable to tools, devices and equipment*

IEC 61326-1, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

IEC 61477, *Live working – Minimum requirements for the utilization of tools, devices and equipment*

IEC 61672-1, *Electroacoustics – Sound level meters – Part 1: Specifications*

IEC 62271 (all parts), *High-voltage switchgear and controlgear*

ISO 286-1, *Geometrical product specifications (GPS) – ISO code system for tolerances on linear sizes – Part 1: Basis of tolerances, deviations and fits*

ISO 286-2, *Geometrical product specifications (GPS) – ISO code system for tolerances on linear sizes – Part 2: Tables of standard tolerance classes and limit deviations for holes and shafts*

ISO 3744:2010, *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering method for an essentially free field over a reflecting plane*

CISPR 11, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

CIE 015.2, *Colorimetry*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61318 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

accessory

item used to lengthen the handle or the *contact electrode* or *contact probe*, to improve the efficiency of the *contact electrode* or *contact probe* or to enable the *contact electrode* or *contact probe* to reach the part to be tested